With the author's regards.

NOTES ON ARCHÆOZOON.

By G. F. Matthew, LL.D., F. R. S. C.

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ARTICLE II.

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Read 4th Dec., 1906.

In the year 1891, the writer of the following note, then President of this Society, brought before it certain discoveries relating to organisms of low type found in the ancient rocks around St. John.

This was partly in the presidential address of that year, and partly in an article on "Eozoon and other low organisms in Laurentian rocks at St. John." *

In part these two papers relate to the genus Archæozoon, examples of which had then lately been brought to the writer's attention. As this organism was subsequently found in other localities than that from which it was originally described, and as a similar organism has recently been found in the Pre-Cambrian rocks in the Rocky Mountains by officers of the U. S. Geological Survey, and has been figured in a Bulletin of the Geological Society of America by Hon. C. D. Walcott, Director of the above-named Survey, the present seems a fitting time to gather up the information relative to Archæozoon and present it before this Society.

In the presidential report above cited, Archæozoon is referred to in the following terms: *

"The second horizon of organic forms is in the upper limestones of the Upper Series (of the Laurentian area of rocks in the vicinity of St. John). The organism found here . . . . . is one of the calcareous coral-like structures, somewhat like certain forms found in the basal beds of the Cambrian (and of the Ordovician). Its structure has not yet been studied, but *en masse* it consists of elongated cylindrical objects, which are from one inch to

* Nat. Hist. Soc. of N. B., Bull. IX, p. 32, par. 3.

three inches across, and several inches in length (described further on as *Archaeozoon Acadiense*). The object consists of a cumulative growth of conical partitions, layer upon layer, building up a cylindrical body that in cross-section looks not unlike a part of a tree-trunk, and which bears a general resemblance to *Stromatopora rugosa*, Hall. The upper limestone, at the base of which this organism is found, has suffered greatly from denudation, as we find areas of the 'Upper Series' which do not appear to have the upper limestones. Good examples of the fossil are known only from one locality."

The part of the article on "Eozoon and other low organisms at St. John," referring to Archæozoon, is as follows:

"Some months since the attention of the writer of this communication was called by Mr. Wm. Murdoch, C. E., of St. John, to the appearance of some fragments of crystalline limestone which were thought to be pieces of petrified wood. The fragments had been broken from ledges at a locality ('Green Head') in the Upper Series of the Laurentian area (of rocks) near St. John, N. B.

"These fragments had apparently a concretionary structure but differed from any concretionary limestone the writer had seen before. The pieces exhibited were not sufficient to show the nature or origin of these apparent concretions, and an early opportunity was embraced of visiting the locality and making observations on the spot. This visit resulted in the discovery of an extensive reef of limestone, in which immense numbers of these peculiar fossils are preserved in a remarkably perfect condition.

"The reef began its growth on a bottom of fine sand, now converted into a quartzite rock, which forms an important part (member) of the 'Upper Series.' There (at the bottom of the reef) the object consists of a multitude of small, short, closely set columns, which grew tier upon tier, with at first more or less sand between the tiers.

"It may be observed, also, that these crowded clusters of columns were often cut off over considerable areas by thin horizontal layers of (amorphous) mineral matter, perhaps indicative of the incursion of (fine) sand or other sediment, but the

growth was almost immediately renewed by a new set of columns, occupying the fresh surface of mud that covered the old one.

"In the upper part of the reef in which the columns flourished and grew luxuriently, it is very interesting to observe the apparent effort put forward by some of these columns to overtop their fellows. Those that grew most vigorously would spread and crowd the adjoining ones, so that they were compelled to elevate the centres of their calcareous layers. Thus in these crowded columns the layers became almost (inversely) funnel-shaped, while in the broad ones, that had plenty of room to grow, they flattened out to an (inverted) saucer shape, or in some cases are almost entirely flat. It is these funnel-shaped layers which, when they are cut across, have the appearance of the ends of sticks of wood. They have thus given to unpractised observers the impression that the rock consisted of crowded masses of wood turned to stone.

"Sometimes one of these columns was quite crowded out of existence by its more vigorous neighbors. In other instances we appear to have cases where the columns bifurcated, and formed two columns to occupy a space otherwise vacant on the sea bottom. Another feature of these columns, which helped to carry out the deception that led those who first saw the rock to suppose that each column was a stick of wood, was that the silicious* (dolomitic) layers are thinner, and sometimes fail altogether at the centre of the column. As the spaces between the calcareous layers are filled with mineral matter of a darker hue than the calcareous substance, (and the centre of the columns is also of a dark color), the columns appear to have a dark centre, like the pith of a tree; hence they were thought to be the trunks of 'hardwood' or exogenous trees.

"This reef of calcareous columns was about one hundred and fifty feet deep, but its lateral extent is not known, as it is cut off on one side by a fault, and on the other passes beneath the waters of the St. John river.

"A peculiarity of these calcareous columns is that they are usually surrounded by a casing of more magnesian substance; thus a space of a quarter of an inch or more may separate two

* Prof. F. D. Adams, who has examined these layers, says they are dolomitic.

of these columns, this space being (partly) filled with an irregular and broken calcareous or calcareo-magnesian deposit.

"The microscopic character of these columns and the layers has not been studied, but to the naked eye the more dolomitic layers, when well preserved, are distinctly beaded, as if they were filled up chambers of an organism in which the chambers were imperfectly separated from each other.

"A peculiarity of this object is that of the sudden cessation of growth, either of a part, or of the whole, of an individual column. In a case of this kind the space thus left vacant is occupied by the extension over it of the layers of a neighboring column, or by the growth of one or more new individuals on the senile surface.

"These new columns have in all cases a dome-shaped or hemispherical form, which they retain until they are as large, or larger, than a finger-end, after which the layers begin to flatten.

"There is a fossil described by Professor James Hall (*Cryptozoon proliferum*) occurring in the Calciferous rocks at Greenfield, N. Y., which at first glance strikingly resembles the Acadian fossil above described,* but it differs in the mode of growth, as it consists of rosettes of various sizes, consisting of concave laminæ (while those of *Archaeozoon Acadiense* are convex)."

This is all that was published about this peculiar fossil at the time it was first investigated. But two years afterward Dr. W. D. Matthew, then a fellow of Columbia College, New York, undertook an examination of the "Crystalline rocks near St. John," and in the course of his investigations met with this fossil in the limestones of the "Upper Series" in the peninsula north of the city of St. John, on the shore of the "Narrows" of the St. John river.† The locality is in the same basin of limestones as that containing the typical forms from Green Head.

In 1894 another locality for this fossil was discovered by Mr. Geoffrey Stead on Douglas avenue, on the ridge between the harbor of St. John and the river St. John above the "Falls." The fossil here is not quite at the base of the limestone, but is not far from it, and the individuals are smaller than many of those seen

* See 36th Ann. Rep. N. Y. State Mus, Appendix.
† Nat. Hist. Soc. of N. Brunsw'k, Bull. XII, p. 16.

at Green Head. This locality is in a more southerly basin of the limestones of the "Upper Series" than that of the Green Head locality, and the locality where it was observed by Dr. W. D. Matthew.

The latest occurrence of the fossil noted was at Black River, on the coast of the Bay of Fundy, eastward of St. John, and quite detached from any known area of Laurentian rocks. It occurs at the side of the road leading from Black River to Loch Lomond as small boulders in a conglomerate at the base of the red Devonian rocks of the latter place. Extending from the point where this occurrence was observed, for several miles to the westward, is a ridge of gray grits, which may be a coarser form of the quartzites of the "Upper Series" of the Laurentian area seen around St. John. If this ridge is of the "Upper Series," the position of the Archæozoonal limestone would be along its southern face, against which the Devonian rocks now rest, and which may therefore be supposed to cover the Laurentian limestones if present at this place.

The resembling fossils found by Mr. Bailey Willis, of the U. S. Geological Survey, in northwestern Montana, have been observed in a limestone of Pre-Cambrian age, called the Siyeh limestone, and have been named *Cryptozoon frequens*. The excellent half-tone reproductions of this fossil show how close they are in general structure to *Archaeozoon Acadiense*, especially in their convex growth and in the spaces between the columns. The microscopic structure of *Cryptozoon frequens* is not described in the paper I have cited, and there is no further means of comparison with the Acadian (Canadian) fossil; but that Pre-Cambrian limestones in the Rocky Mountain region, clearly shown to be such by their relation to a well-defined Cambrian terrane, should contain organic structures so like the Archæozoon, is an important and suggestive addition to our knowledge of the earliest forms of life.

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* Bull. Geol. Soc. of America, Vol. 17, pp. 4, 6, 8, 10, 11, 19, pl. 19.

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EXPLANATION OF PLATE

FIG. 1.—Geological sketchmap of the vicinity of St. John, N. B., (from the map of the geological survey) showing where Archæozoon has been found.

Areas occupied by Pre-Cambrian schists and intrusives. (Marked by small crosses).

Pre-Cambrian limestones, the large area is not continuous as represented. (Marked by dots).

Cambrian (and Lower Ordovician). (Marked by vertical lines).

Little River plant-bearing terrane. (Marked by horizontal lines).

Overlying red conglomerate and shales. (Marked by circles).

Localities where Archæozoon has been found. (Marked by large crosses.

N. B.—the locality at Black River is outside of the limits of this map (to the S. E.).

FIG. 2.—(The original figure of this form published in Bulletin IX, 1880). It is a vertical section of Archæozoon Acadiense, one-half diam. It shows well the alternating convex layers of a single column. From the Upper Series of the Laurentian area at Green Head, St. John Co., N. B.

FIG. 3.—Horizontal section of this species, one-seventh diam. It shows the spaces between the columns filled with a magnesian deposit. After the hardening of the limestone mass it suffered somewhat from lateral squeezing and from faulting, and the columns were somewhat broken up.

N. B.—The parallel striation on the surface of the rock is due to the saw. From Green Head, St. John Co., N. B.

FIG. 4.—Vertical section of a group of weathered columns of Archæozoon Acadiense one-sixth diam. This shows the origination of a colony of Archæozoon on horizontal layers of calcareous mud, at first the growth was irregular and sporadic; then gradually developing distinct vertical columns, the margins of the columns are indicated by a pale gray coloring; in the upper, more weathered portion of the block, the convex layers of the fossil are more distinctly visible. From limestone of the southern basin of the Upper Series at Douglas Avenue, St. John, N. B.


Kennebecasis Bay
Green Hd.
St John Harbor
X Localities where Archaeozoon has been found

Fig. 1.

Fig. 2.

Fig. 3.

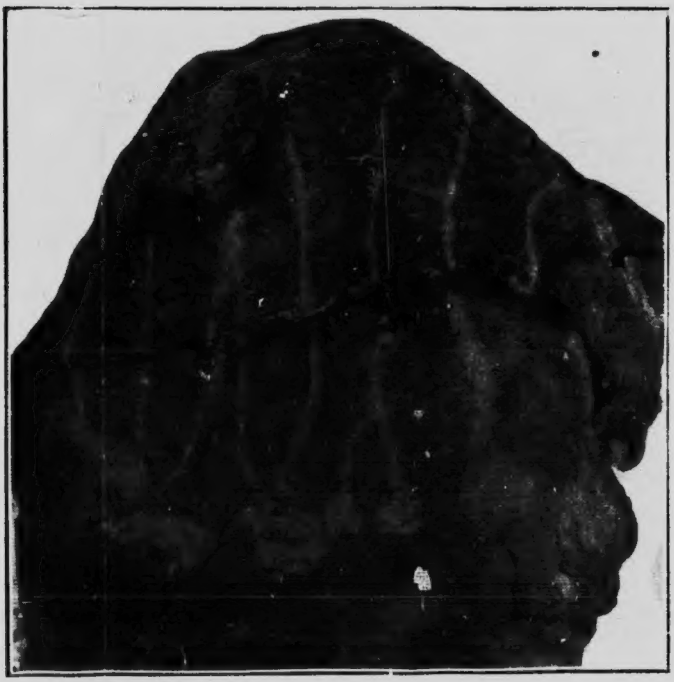

Fig. 4.